and at least one device that detects interferometric change in reflected light generated when light is transmitted through the polishing pad to the film.

41 ~~92~~. The chemical mechanical polisher of claim ~~91~~ 40, wherein the at least one device comprises a detector to detect said interferometric change and an analyzer for controlling the chemical mechanical polisher in response to the detected interferometric change.

G1 cont'd.

42 ~~93~~. The chemical mechanical polisher of claim ~~92~~ 41, wherein the analyzer analyzes interferometric change in the reflected light to determine a change in dimension of the film.

43 ~~94~~. The chemical mechanical polisher of claim ~~93~~ 42, wherein the analyzer analyzes interferometric change in the reflected light using interferometry at one wavelength.

44 ~~95~~. The chemical mechanical polisher of claim ~~93~~ 42, wherein the analyzer analyzes interferometric change in the reflected light using spectrophotometry over a continuous range of wavelengths.

45 ~~96~~. The chemical mechanical polisher of claim ~~93~~ 42, wherein the analyzer analyzes interferometric change in the reflected light to determine a change in thickness or planarity of the film.

46 ~~97~~. The chemical mechanical polisher of claim ~~91~~ 40, wherein incident and reflected light are transmitted through a rotating fiber optic cable embedded in a rotating platen below the polishing pad.

38

47 ~~98~~. The chemical mechanical polisher of claim 40 ~~91~~, wherein incident light is transmitted to a section of the film.

48 ~~99~~. The chemical mechanical polisher of claim 40 ~~91~~, wherein incident light is transmitted to more than one section of the film.

49 ~~100~~. The chemical mechanical polisher of claim 40 ~~91~~, wherein the light source produces a light of at least one wavelength between 200 and 11,000 nanometers.

G1 cont'd.

50 ~~101~~. The chemical mechanical polisher of claim 40 ~~91~~, wherein the light source produces laser light.

51 ~~102~~. A method of processing a film comprising

polishing the film with a rotating polishing pad;

illuminating at least one section of the film with light transmitted through the rotating polishing pad during polishing of said at least one section; and

detecting interferometric change in light reflected from the at least one illuminated section of the film.

52 ~~103~~. A method of claim 51 ~~102~~, wherein polishing the film comprises polishing said film in a chemical mechanical polisher comprising

at least one light source that illuminates said at least one section of the film by directing light through said polishing pad to the film;

39

and at least one device that detects said interferometric change.

G1 cont'd.

53 ~~104~~. A method of claim 52 ~~103~~, wherein the reflected light passes through and out of the polishing pad before said detection step..

57 ~~105~~. A method of claim 52 ~~103~~, wherein the at least one device comprises a detector to detect said interferometric change and an analyzer for controlling the chemical mechanical polisher in response to the detected interferometric change.

54 ~~106~~. A method of claim 53 ~~104~~, wherein said interferometric change is detected when said at least one section of the film passes over said at least one device.

59 ~~107~~. A method of claim 51 ~~102~~, wherein more than one section of the film is illuminated.

58 ~~108~~. A method of claim 52 ~~103~~, wherein the light directed through the polishing pad to the at least one section of the film comprises at least one wavelength between 200 and 11,000 nanometers; and

the interferometric change in the reflected light is analyzed over one or more wavelengths.

60 ~~109~~. A method of claim 51 ~~102~~, wherein polishing the film comprises reducing the thickness of the film or planarizing the film.

61 ~~110~~. A method of claim 51 ~~102~~, wherein polishing endpoint is detected based on said interferometric change in the reflected light.

40

62 ~~111~~. A method of claim 61 ~~110~~, wherein the film is a metal film.

63 ~~112~~. A method of claim 51 ~~102~~, wherein the film is formed over a substrate.

64 ~~113~~. A method of claim 63 ~~112~~, wherein the substrate comprises at least one of an insulating material, a conductive material, a semiconductive material, a silicon wafer, a gallium arsenide wafer and a silicon on insulator.

G1 cont'd.

65 ~~114~~. A method of claim 63 ~~112~~, wherein the substrate comprises a semiconductor device over a silicon wafer.

66 ~~115~~. A method of claim 51 ~~102~~, wherein the film comprises at least one of an SiO_2 layer, a spin-on-glass layer, a tungsten layer, an aluminum layer, a silicon layer and a photoresist layer.

67 ~~116~~. A method of claim 51 ~~102~~, wherein the film comprises a dielectric layer over a semiconductor device.

68 ~~117~~. A method of claim 51 ~~102~~, wherein the film comprises at least one dielectric layer over at least one metal layer.

69 ~~118~~. A method of claim 51 ~~102~~, wherein the film comprises a part of a semiconductor device or an integrated circuit.

55 ~~119~~. A method of claim 53 ~~104~~, wherein light from the light source that illuminates said at least one section and reflected light pass through a fiber optic cable embedded in the rotating polishing pad.

41

56 ~~120~~. A method of claim 55 ~~119~~, further comprising controlling thickness change in the film in response to the detected interferometric change.

70 ~~121~~. A method of claim 51 ~~102~~, wherein said at least one section of the film is illuminated with light including at least one wavelength between 200 and 11,000 nanometers.

71 ~~122~~. A semiconductor device including a film processed by the method of claim 51 ~~102~~.

G1 cont'd.

72 ~~123~~. An integrated circuit including a film processed by the method of claim 51 ~~102~~.

73 ~~124~~. A method of making a planarized substrate comprising

polishing a film over a substrate with a rotating polishing pad;

illuminating at least one section of the film with light transmitted through the rotating polishing pad during polishing of said at least one section; and

detecting interferometric change in light reflected from the at least one illuminated section of the film.

74 ~~125~~. A method of claim 73 ~~124~~, wherein polishing the film comprises polishing said film in a chemical mechanical polisher comprising

at least one light source that illuminates said at least one section by directing light through the rotating polishing pad to the film;

42

and at least one device that detects said interferometric change.

75 ~~126~~. A method of claim 74 ~~125~~, wherein the reflected light passes through and out of the rotating polishing pad before said detection step.

79 ~~127~~. A method of claim 74 ~~125~~, wherein the at least one device comprises a detector to detect said interferometric change and an analyzer for controlling the chemical mechanical polisher in response to the detected interferometric change.

G1 cont'd.

76 ~~128~~. A method of claim 75 ~~126~~, wherein said interferometric change is detected when said at least one section of the film passes over said at least one device.

80 ~~129~~. A method of claim 73 ~~124~~, wherein more than one section of the film is illuminated.

81 ~~130~~. A method of claim 73 ~~124~~, wherein the at least one section is illuminated with light including at least one wavelength between 200 and 11,000 nanometers; and

the interferometric change in the reflected light is analyzed over one or more wavelengths.

82 ~~131~~. A method of claim 73 ~~124~~, wherein polishing the film comprises reducing the thickness of the film or planarizing the film.

83 ~~132~~. A method of claim 73 ~~124~~, wherein polishing endpoint is detected based on said interferometric change in the reflected light.

43

~~133~~ 84. A method of claim ~~132~~ 83, wherein the film is a metal film.

~~134~~ 85. A method of claim ~~124~~ 73, wherein the film is formed directly on a substrate.

~~135~~ 86. A method of claim ~~124~~ 73, wherein the substrate comprises at least one of an insulating material, a conductive material, a semiconductive material, a silicon wafer, a gallium arsenide wafer and a silicon on insulator.

G1 cont'd.

~~136~~ 87. A method of claim ~~124~~ 73, wherein the substrate comprises a semiconductor device over a silicon wafer.

~~137~~ 88. A method of claim ~~124~~ 73, wherein the film comprises at least one of a SiO_2 layer, a spin-on-glass layer, a tungsten layer, an aluminum layer, a silicon layer and a photoresist layer.

~~138~~ 89. A method of claim ~~124~~ 73 wherein the film comprises a dielectric layer over a semiconductor device.

~~139~~ 90. A method of claim ~~124~~ 73, wherein the film comprises at least one dielectric over at least one metal layer.

~~140~~ 91. A method of claim ~~124~~ 73, wherein the film comprises a part of a semiconductor device or an integrated circuit.

~~141~~ 77. A method of claim ~~126~~ 75, wherein light from the light source that illuminates said at least one section and reflected light pass through a fiber optic cable embedded in the rotating polishing pad.

44

~~142~~ 78. A method of claim ~~141~~ 77, further comprising controlling thickness change in the film in response to the detected interferometric change.

~~143~~ 92. A planarized substrate made by the method of claim ~~124~~ 73.

~~144~~ 93. A planarized substrate of claim ~~143~~ 92, which is a silicon on insulator substrate.

~~145~~ 94. A semiconductor device including a planarized substrate made by the method of claim ~~124~~ 73.

G1 cont'd.

~~146~~ 95. An integrated circuit including a planarized substrate made by the method of claim ~~124~~ 73.

~~147~~ 96. In a chemical mechanical polisher for polishing a film over a substrate, the improvement comprising a polishing pad having at least one optical access through which light can be transmitted to a portion of the film on the substrate for the purpose of detecting interferometric change in reflected light generated when light is transmitted through the polishing pad to the at least one portion of the film.

~~148~~ 97. The chemical mechanical polisher of claim ~~147~~ 96, wherein the at least one optical access in the polishing pad is transmissive to light comprising at least one wavelength between 200 and 11,000 nanometers.

~~149~~ 98. The chemical mechanical polisher of claim ~~148~~ 97, wherein the at least one optical access is a portion of a fiber optic cable.

45